

introductory portion, that is not open to serious criticism, and it is much to be regretted that, having taken up so important a task, the author has not performed it more satisfactorily. He may, perhaps, urge that it is a first attempt; but while this would be an excuse for much imperfection of special knowledge, it will not justify the peculiar faults which it has been our unwelcome duty to point out.

MISCELLANEOUS.

On the Phylogeny of the Bopyrinæ.

By MM. A. GIARD and J. BONNIER.

THE Bopyrinæ are comparatively rare animals, and parasitic upon a restricted number of genera of Crustacea belonging to the groups Cirripedia, Ostracoda, Schizopoda, and Decapoda. Confining ourselves for the present to the species parasitic upon Decapoda and especially on the Decapoda of European seas, we may remark this first interesting fact, that every species of Decapod infested by Bopyrinæ is so generally by two or more different species, and that very often in the same locality and sometimes even on the same individual. Thus, we find on *Xantho floridus*, *Cepon pilula*, G. & B., and *Cancerion floridus*, G. & B.; on *Pilumnus hirtellus*, *Cepon elegans*, G. & B., and *Cancerion miser*, G. & B.; on *Portunus arcuatus*, *Cepon Portuni*, Kossm., and *Portunium salvatoris*, Kossm.; on *Pagurus Bernhardus*, *Phryxus Paguri*, Rathke, and *Pleurocrypta Hyndmanni*, Sp. B. & W.; on *Galathea squamifera*, *Pleurocrypta Galathea*, Hesse, and *Gyge Galathea*, Sp. B. & W.; on *Porcellana longicornis*, *Pleurocrypta Porcellana*, Hesse, and *Entoniscus Muelleri*, G. & B.; on *Callianassa subterranea*, *Ione thoracica*, Mont., and *Pseudione* sp., Kossm.; on the species of the genus *Hippolyte*, Bopyrinæ of the genera *Phryxus*, *Gyge*, *Bopyroides*, and *Bopyrina*, &c.

All these Bopyrinæ, even the Entoniscidæ, are in reality external parasites. Nevertheless, according to the position which they occupy upon their host, the Bopyrinæ of the Decapoda may be divided into three distinct ethological groups:—1, abdominal parasites; 2, branchial parasites; 3, visceral parasites. Now the different species infesting the same Decapod generally belong to different ethological groups. If we seek for analogous examples in other families we may cite the Branchiobdellæ, three species of which infest *Astacus fluviatilis*, each in a particular region of the body; and three species, parallel to our European types, have likewise been indicated in the Japanese crayfish. Another example is furnished by the Diptera of the family Œstridæ, several species of which, some cuticular, others cavicular or gastric, infest at the same time certain types of Cervidæ or Equidæ. Facts of this kind, absolutely incomprehensible under the old hypothesis of the fixity of species, become exceedingly instructive if we accept the theory

of descent with modification. They indicate, in fact, that several states of symbiotic equilibrium have been successively established between the phylum of the parasites and that of their hosts. Still more, in the particular case of the Bopyrinæ, we can, by a careful study of the embryogeny, determine the order in which these various states of equilibrium have been produced, follow step by step the modifications caused in the organism by a parasitism gradually becoming more and more complete, and thus give a truly natural classification of these animals.

The first larva of the Bopyrinæ is very uniform throughout the group. By the long duration of its pelagic existence it teaches us that the ancestors of the Bopyrinæ were for a long time free forms. By its general organization it shows us that this ancestral form must have approached the *Ægidæ*, and more especially *Eurydice*. The differential peculiarities which these first larvæ present are furnished chiefly by the sixth pair of thoracic feet, and are in relation with the emergence of the embryo from the host which harboured the parent, and not, as has been supposed, with its entrance into a new host; from this it results that the modifications are numerous, especially in the group in which the parasitism is most decided, that is to say the Entoniscidæ.

The second free larval form has been called by us the *Cryptoniscian embryo* or *Cryptoniscus-stage*, because the males of the Cryptoniscidæ represent in a more complete fashion this transitory phase in the development of the other Bopyrinæ. It is under this form that the fixation of the Bopyrian upon its host is effected at the commencement of its parasitic life. In several Entoniscians (*Portunion Menadis* and *P. Kossmanni*), and in *Phryxus Paguri*, we have ascertained the presence of several Cryptoniscian embryos, attached to adult females provided with males. In some of them we have even observed spermatozoids apparently mature and normal. We may inquire whether, when the place upon the host is thus preoccupied, the Cryptoniscian larvæ do not, at least temporarily, play the part of complemental males. The attached larva speedily undergoes a series of transformations which, in the female Cryptoniscidæ, are accomplished in very different fashion from that which occurs in the other Bopyrinæ.

Further, while in the Cryptoniscidæ the male stops in its development at the second larval form, in the other Bopyrinæ it continues its evolution, and acquires a more or less Idotheiform aspect. We notice also that there exists an astonishing superposition of parasites and a triple parallelism between the genera *Cryptoniscus*, *Zeuxo*, and *Danalia* of the family Cryptoniscidæ, and the genera *Peltogaster*, *Lerneodiscus*, and *Sacculina* of the group Rhizocephala, and the genera *Pagurus*, *Porcellana*, and *Cancer* of the infested Decapoda.

Lastly, the singular coexistence of parasitic Cirripedes in all the types of Decapoda infested by Bopyrinæ, and the existence of forms such as *Phryxus resupinatus*, which, although no longer belonging to the group Cryptoniscidæ are still nevertheless indirect parasites of the Decapoda, lead us to the hypothesis that the Bopyrinæ were

introduced among the Decapoda by the Rhizocephalan Cirripedes. While one branch of the Cryptoniscidæ has remained faithful to its first hosts, another has become adapted to direct parasitism upon the Decapods, and has given origin to the group of *Phryxus*, *Bopyrus*, and the Entoniscidæ.

Thus, by a fact of ethological atavism, would be explained the simultaneous presence, so often ascertained, in the same Decapod, of a Rhizocephalan and a Bopyrian parasite (*Sacculina Carcini* and *Portunium Menadis*, *Entoniscus Porcellane* and *Lernæodiscus Porcellane*, &c.).

The existence of a Phryxoid stage in the evolution of the females of most Bopyrinæ shows that the genus *Phryxus* may be regarded as the stock from which there have issued, on the one hand, the Ioninæ, which are in a manner an exaggeration of it; and, on the other, the asymmetrical branchial Bopyrinæ. This Phryxoid stage is observed in *Pleurocrypta*, *Bopyrus*, *Cepon*, *Ione*, &c. It has caused many errors on the part of the zoologists who first studied these animals. The *Phryxus*-stage of *Cepon typus* was taken by Duvernoy for the male of that Bopyrian. *Phryxus fusticaudatus*, Sp. B. & W., is the *Phryxus*-stage of *Pleurocrypta Hyndmanni*, Sp. B. & W.*; *Phryxus longibranchiatus*, Sp. B. & W., corresponds in part to the *Phryxus*-stage of *Pleurocrypta Galatheæ*, Hesse (non Sp. B. & W.†). In the Entoniscidæ the *Phryxus*-stage appears less distinctly, and it is possible that this group may have diverged from the stock at a very ancient period, which would be in accordance with its more decided parasitism.—*Comptes Rendus*, May 9, 1887, p. 1309.

On Parasitic Castration in Eupagurus Bernhardus, Linné, and in *Gebia stellata*, Montagu. By M. A. GIARD.

In a recent memoir‡ I made known the curious morphological effects produced in several Decapod Crustacea by the castration produced by the presence of Rhizocephalan or Bopyrid parasites. Further and very remarkable examples of these phenomena are presented by the hermit-crabs infested by *Phryxus Paguri*, Rathke, and by the *Gebia* infested by *Gyge branchialis*, Corn. & Panc. Although *Phryxus Paguri* is an absolutely external parasite, the modifications which it occasions are as extensive as those observed in certain Brachyura in consequence of their infestation by Rhizocephalans.

It is well known what are the external sexual characters of the *Eupaguri*. In the female the genital aperture is situated upon the basal joint of the third pair of thoracic feet; in the male this orifice is placed upon the base of the fifth pair of feet, which bears

* We have met with this Bopyrian of the branchial cavity of *Pagurus Bernhardus* at Roscoff, and at Equihen, near Blosne-sur-Mer.

† We have studied this parasite of *Galathea squamifera* at Roscoff and at Fécamp.

‡ Bull. Sci. du Nord, tome xviii. (1887), pp. 1-28. Translated in 'Annals,' May 1887, pp. 325-345.